successful essay will be the property of the Association, which will assume the care of its publication. 6. Any intimation tending to reveal the authorship of any of the essays submitted, whether directly or indirectly conveyed to the Committee or to any member thereof, shall exclude the essay from competition. 7. The award of the prize will be announced by the undersigned Committee; and will be publicly declared by the President of the Association at the meeting in June, 1882. 8. The amount of the prize will be given to the successful competitor in gold coin of the United States, or, if he prefer it, in the shape of a gold medal bearing a suitable device and inscription.

Signed, { F. T. MILES, M.D., *Baltimore.*
J. S. JEWELL, M.D., *Chicago.*
E. C. SEGUIN, M.D., *New York.*

CHESAPEAKE ZOOLOGICAL LABORATORY.

Dr. W. K. Brooks, Director of the Chesapeake Zoological Laboratory, established under the auspices of the the Johns Hopkins University, in his report for 1880 states: By the liberality of the Trustees, it was possible to spend a much longer period than hitherto at the seaside, and provided with a more liberal outfit, including a steam launch which was built, for our use in the last spring, at Bristol, R. I., and has proved a very efficient auxiliary. The necessary books, dredges, and other instruments were also provided by the University. In addition to the opportunities afforded to three of the members of our own academic staff, three other gentlemen, devoted to the study of Zoology, were invited to avail themselves of the scientific facilities of the station.

The laboratory was opened at Beaufort, N. C., on April 23, 1880, and closed on September 30, after a session of twenty-three weeks. It was supplied with working accommodations for six investigators, and the facilities which it afforded were used by the following six persons: W. K. BROOKS, PH. D., Director; K. MITSUKURI, PH. B., Fellow in Biology; E. B. WILSON, PH. B., Fellow in Biology; F. W. KING, A. M., Professor of Natural Science, Wisconsin State Normal School; H. C. EVARTS, M. D., Academy of Natural Sciences, Philadelphia; H. F. OSBORNE, PH. D. Fellow of the College of New Jersey.

Beaufort was selected for our third season's work because it is the nearest accessible town, south of Baltimore, which is favorably situated for zoological study. The advantages of a location in a town are well shown by the fact that the expenses of a session of twenty-three weeks this year were considerably less than those of a ten weeks session the year before.

The scientific advantages of Beaufort are very great; the most important is the great difference between its fauna and that of our northern Atlantic coast.

The configuration of our coast line is such that Cape Hatteras, the most projecting point south of New York, deflects the warm water of the Gulf Stream away from the coast, and thus forms an abrupt barrier between a cold northern coast and a warm southern one. The fauna north of this barrier passes gradually into that of southern New England, while the fauna south of this barrier passes without any abrupt change into that of Florida, but the northern fauna is sharply separated by Cape Hatteras from the southern.

As the laboratory of the U. S. Fish Commission and Mr. Agassiz's laboratory at Newport afford opportunites for work upon the northern fauna, it seemed best for us to select a point south of Cape Hatteras in order to study the southern fauna with the same advantages, and as Beaufort is the only town near the Cape which can be reached without difficulty, it was chosen as the best place for the laboratory.

The situation of this town is exceptionally favorable for zoölogical work, for the surrounding waters present such a diversity of conditions that the fauna is unusually rich and varied.

Close to the town there are large sand bars, bare for miles at low tide, and abounding in animal life. From these we could collect an unfailing supply of *Amphioxus, Renilla; Limulus, Balanoglosus,* Sea Urchins, and a great variety of Molluscs and Crustacea.

The mud flats furnished us with another fauna, and yielded a great variety of Annelids, a new set of species of Crustacea and Molluscs, Gephyreans, Echinoderms, and Polyps. The large salt marshes gave us a third fauna, and a short distance inland large swamps of brackish and fresh water furnished still other conditions of life.

As the town is situated at the point where Gore Sound connects Pamlico Sound with Bogue Sound we were within easy reach of a continuous sheet of landlocked salt water more than a hundred miles long, and these Sounds furnished still another collecting and dredging ground, abounding in Corals, Gorgonias, Ascidians, Star Fish, Sea Urchins, and a new set of Molluscs and Crustacea.

As most of the shores are flat and sandy, those animals which live upon a sandy bottom are much more abundant than those which attach themselves to solid bodies, but the stone breakwaters at Fort Macon, the wharves at Beaufort and Morehead City, and the large oyster beds which are found in the sounds furnish a proper habitat for many fixed animals, and yielded us a rich supply of Hydroids, Corals, Ascidians, Sea Anemones, Sponges, Cirrhipeds, &c. The ocean beach, within a short distance of the town, furnished still another fauna, and a soil of three miles from the laboratory carried us to a good locality for ocean dredging.

The greatest advantage of the locality is the richness of its pelagic fauna. There are very few points upon land which are so situated that the surface animals of mid-ocean can be procured in abundance for laboratory work, and as careful work is very difficult on shipboard, a laboratory which can be furnished with a good supply of living pelagic animals presents opportunities for work in an extremely interesting and almost new field.

The Gulf Stream is constantly sweeping these animals northwards along the North Carolina coast, and as the tide sets in through Beaufort Inlet into the Sounds the floating animals are carried with it. Such oceanic animals as *Physalia* and *Porpita* were frequently thrown, uninjured and in perfect health, upon the beach within twenty feet of the laboratory, and during the season we found nearly all the Siphonophoræ which are known to occur upon our Atlantic coast.

With all these advantages we enjoyed a mild and uniform climate which enabled us to work in perfect comfort during the hottest months of summer.

The zoölogical resources of Beaufort have not escaped the attention of American naturalists, and there are few places upon our coast, outside of New England, where more zoölogical work has been done. In 1860, Drs. Stimpson and Gill spent a season in dredging and collecting in the vicinity of Beaufort, Cape Lookout and Cape Hatteras, and an account of their work was published in *The American Journal of Science.* Dr. Coues, who was stationed at Fort Macon during the war, occupied himself for two years in collecting the animals which are found here, and he published a series of papers on the "Natural Histsry of Fort Macon and Vicinity" in the Proceedings of the Academy of Natural Sciences of Philadelphia.

These papers, which were continued by Dr. Yarrow, contain copious and valuable notes on the habits and distribution of the animals which were observed, and we found them a great help to us. These two naturalists found four hundred and eighty species of animals in the vicinity of Beaufort. Of these four hundred and eighty, two hundred and ninety-eight are vertebrates, and one

hundred and eighty-two are invertebrates. Of the vertebrates twenty-four are mammals, one hundred and thirty-three are birds, twenty-seven are reptiles, six batrachians, ninety-seven fishes and eleven selachians. Of the invertebrates, one hundred and forty-seven are molluscs, twenty-one are crustaceans. The list of vertebrates is very nearly exhaustive, and we made no additions to it, but the list of invertebrates is obviously very imperfect, and, although we made no attempt to tabulate the species which we observed, there would be no difficulty in enlarging the list twenty or thirty fold.

Among other naturalists who have spent more or less time at Beaufort, I may mention Professor L. Agassiz, Professor E. S. Morse, Dr. A. S. Packard, Professor Webster, and Professor D. S. Jordan. Professor Morse procured most of the material for his well known paper on the Systematic Position of the Brachiopoda on the sand bars in Beaufort Inlet.

I will now attempt to give a very short statement of some of the leading points in our own summer's work. Much of our time was spent in studying the development of the Crustacea, since this is one of the most important fields for original work upon our southern coast. The supply of material is almost inexhaustible, and would employ a number of students for many years. The life history of the Crustacea is of great interest in itself, and the recent species are so numerous and diversified that there is no group of animals better adapted for studying the general laws of embryonic development in their relation to the evolution of the group.

These considerations have led us to devote especial attention to this group during this and the preceding seasons. One of the published results of the first season's work was an illustrated account of the metamorphosis of *Squilla*, a representative of a somewhat aberrant group of Crustacea. During the second season, a member of our party, Professor Birge, made a very thorough study of the development of *Panæus*, one of our crabs, and the account of his observations, with drawings, was ready for publication several months ago. At Beaufort, we spent most of our time upon this subject, and figured more than eight hundred points in the development of various Crustacea.

Among these, I wish to call especial attention to our observations upon the development of the Sergestidae; the least specialized of the stalk-eyed Crustacea. This very peculiar group was not known to occur upon our coast until we found a few specimens of one genus at Fort Wool, and the same genus —*Lucifer*—in great abundance at Beaufort, associated with another genus which is also new to North America. As nothing whatever was known of the development of *Lucifer*, we made every effort to obtain the eggs and young, and after four months of almost fruitless labor we finally succeeded in finding all the stages of the metamorphosis, and figured them in a complete series of ninety-nine drawings. We also obtained a somewhat less complete series of figures of stages in the life history of the second Sergestid.

Our only motive in this work was the desire to fill a gap in our knowledge of crustacean development, by supplying the life history of a very interesting group of animals, but the result was found to have a very unexpected value, since it contributes to the discussion of a number of problems in general embryology and morphology, and is the most significant crustacean life history which has ever been studied.

The following are some of the more important points:

The egg undergoes total regular segmentation.

There is no food yolk, and cleavage goes quite through the egg.

There is a true segmentation cavity.

Segmentation is rhythmical.

There is an invaginate gastrula.

The larva leaves the egg as a Nauplius, and passes through a protozoan stage, and a schizopod stage.

The fifth thoracic segments and appendages are entirely wanting at all stages of development.

Another interesting group which was studied is the Porcellanidae, the least specialized of the true crabs. The adults of our American species are almost restricted to our southern waters, although the swimming larvæ are carried north by the Gulf Stream. Within the last two years two northern naturalists have studied these floating embryos upon the south coast of New England, but as they were working upon stragglers so far from home their accounts are incomplete and somewhat contradictory. Our advantages at Beaufort enabled us to contribute towards the solution of this confused subject by raising one species of *Porcellana* from the egg.

We also raised six other species of crabs from the egg, and made drawings of the more important stages of development. One of the species which was thus studied is the edible crab. Its metamorphosis has never been figured, and although it presents no unusual features, its economic importance gives value to exact knowledge of its life history.

Mr. Wilson also studied the development of one species of Pycnogonida, a group of very peculiar Arthropods, distantly related to the spiders. As he has paid especial attention to the systematic study of this group, and is now engaged in describing the Pycnogonids collected in the Gulf Stream by Mr. Agassiz, the opportunity to study them alive in the laboratory has been a great advantage to him.

Another important investigation is the study, by Mr. Wilson, of the embryology of the marine Annelids. Although the representatives of this large group are abundant and widely distributed, little was known of the early stages of their development until he procured the eggs of several species and studied them at Beaufort. This investigation has shown, among other things, that the accepted division of Annelids into two great groups, the Oligochæta and Polychæta, is not a natural method of classification. The work upon the development of marine Annelids was supplementary to an investigation which Mr. Wilson carried on last spring at Baltimore, and which he will continue this winter, upon the development of land and fresh water Annelids.

As much time as possible was given this season to the study of the hydroids and jelly-fish of Beaufort. The life histories of several of them were investigated, a thorough anatomical study of some of the most important forms was carried on, and nearly two hundred drawings were made. It is almost impossible to complete a study of this kind in a single season, but if one or two more summers can be given to the work, we have every reason to hope for valuable results; for although the North Carolina coast is the home of many species which are only found as stragglers upon our northern coast, and of other species which are not known to occur anywhere else, and of some genera and families which are new to the North American coast, this field has suffered almost total neglect.

Nearly three months of the time of two members of our party, Mitsukuri and Wilson, were given to the study of the habits, anatomy and development of *Renilla*, a compound Polyp very much like that which forms the precious coral, but soft and without a stony skeleton. The animals which form the community are so intimately bound together that the community, as a whole, has a well marked individuality distinct from that of the separate animals which compose it. The compound individuality of *Renilla* is quite rudimentary as compared with that of a Siphonophore, and as there is no trace of it in the closely allied Gorgonias, it furnishes an excellent field for studying the incipient stages in the formation of a compound organism by the union and specialization of a community of independent simple organisms. With this end in view the anatomy of the fully developed community was care-

fully studied, and the formation of a community was traced by rearing a simple solitary embryo in an aquarium until a perfect community has been developed from it by budding. During the process of development the law of growth by which the characteristics of the compound organism are brought about was clearly exhibited, and it is fully illustrated by nearly one hundred drawings.

One of the most interesting results of our work is the explanation, by Mr. Wilson, of the origin of the metamorphosis of the larva of *Phoronis*, a small Gephyrean worm which lives in a tube. Several of the most noted embryologists of Europe have studied the development of *Phoronis*, and our knowledge of its life history is due to their combined labors. Last summer Mr. Wilson reviewed the subject, and added some important points, and during the present season he has shown by the comparison of a great number of allied forms, that the very peculiar metamorphosis admits of an extremely simple explanation. The adult is sedentary and confined to its sand tube, while the larva is a swimming animal totally different in structure. The change from the larva to the adult is very rapid and violent. It occupies only a few minutes, and during the change the larva becomes turned wrong side out, so that what was internal is external. Mr. Wilson's comparison shows that *Phrronis* was originally a free animal, and that the structural peculiarities which fit the adult for sedentary life in a tube are of recent acquisition. The larva has, however, retained its ancestral adaptation to a swimming life in order to provide for the distribution of the species. There must have been a time, in the evolution of the species, when the adult was imperfectly adapted to a sedentary life, and also imperfectly adapted to a swimming life, and if the development of the individual were a perfect recapitulation of all the stages in the evolution of the species, we should have, between the swimming larva and the sedentary adult, a stage of development during which the adaptation is not quite perfect for either mode of life. It is clearly an advantage for the animal to pass through this stage as quickly as possible, or to escape it altogether. The peculiar metamorphosis enables the larva to remain perfectly adapted to a locomotor life until the occurrence of the sudden change which fits it for life in a tube, and Mr. Wilson has pointed out the manner in which the metamorphosis has been acquired in order to bridge over the period of imperfect specialization. This explanation is somewhat similar to that which Lubbock has given of the origin of the metamorphosis of insects, and we may hope that the same method of investigation will throw light upon the significance of other remarkable instances of metamorphosis in the Invertebrates.

THE MATERIALISTIC ORIGIN OF THE SEXES.

By Andrew Dewar.

Materialism is yet in its infancy. Born of human learning, weaned in scientific research, and cradled in the toleration of an enlightened civilization, its advent marks an epoch in the history of humanity. Should there be fearful shadows in its progress, where loiter grim doubts and gloomy forebodings, these are only consequent to its youth, and the necessary result of the light from a sun whose slanting rays only reach us. But even as the noonday sun chases away the shadows in its splendor, so we are assured that no doctrine in these enlightened days will ever be accepted which does not in its maturity shine on the human race for true knowledge and good.

"All knowledge is our province," said Bacon, and we would be less than men if any phenomenon in nature was considered inscrutable by us, the highest outcome of Nature. Thinking thus, one of the most curious problems is that of the sexes; and the value of the doctrine of Materialism is apparent when we come to question its cause, for no natural law professes even to offer an hypothesis on the subject.

It may here be asked, what is the doctrine of Materialism? As enunciated by the most advanced physicists, it is that "Matter contains within itself the promise and potency of every form and quality of life." This, it will be correctly said, is only a statement, not a *cause*—an assumption that requires proof, not a proposition of fact which may be demonstrated with the facility of a problem in Euclid. Granted; but it will be admitted that if we can show how the sexes originate from matter and its inherent properties, Materialism must be more than an assertion. This without further introduction we now propose to discuss.

Taking matter and its properties as the only foundation we can build on with safety, we ask What is Matter?

After long years of experiment and failure we answer this question with a firm assurance in several things:

First. The Indestructibility of Matter. This involves both the eternity of matter and the eternity of the properties of matter. Nothing exists outside of matter. Nothing but matter and its properties exist. Nothing can be taken from matter, nothing can be added to it. Whatever properties matter may have had, matter must have now; and, *vice versa*, whatever properties matter has now, matter has always had.

Secondly. Matter is composed of elements of which sixty-four are known. Everything consists of those elements, their combinations, changes, and properties. Whatever form they take now, under similar circumstances they would either in the past or future also assume.

This is the foundation of Materialism, and so far as it goes is perfectly clear and logical. Presuming that no force exists outside of matter, the *properties of matter* must account for every phenomenon in matter, and should they fail the premises fail also, and the fact is made certain that a force exists outside of matter, and *ergo* that Materialism is dead.

What, then, are the properties of Matter?

Here there is confusion and disagreement. Gravitation, cohesion, and chemical attraction are the three forces which have been popularly supposed to control matter; but when Huxley pertinently asked what these forces are, he found them not forces at all, but mere names or effects of a cause or causes unknown. Even Evolution, from which so much was expected and preached, has fallen into disgrace, and proved to be no force or cause either, but merely an "orderly sequence of phenomena" from some cause or causes unknown. How are we, then, to discover those unknown causes? If Materialism be true, they must exist; but Materialism cannot be maintained as a doctrine until we show that they do exist and what they are.

We are thus led back to our premises again—to matter and the elements—and we say, according to materialistic doctrine, if sex exists in matter now, sex must always have existed. Consequently, if matter was once a sheer chaos, or, as the most daring of physicists assert, a universal firemist, then sex in some form or another existed in that chaos or in that mist. As, assuredly, it did not exist in the form of any kind of life we are acquainted with, we are led to ask *if matter does not contain within itself some inherent sexual or dual qualities.* If it does, Materialism is alive; if not, Materialism is dead.

Matter is composed of sixty-four elements, more or less; are these elements all alike in kind, or can we trace a sex or duality in them? Fortunately for our doctrine we can. Although stated by eminent chemists to be of no importance, and made "solely for the sake of simplicity," the elements have long been divided into metallic and non-metallic classes. All the elements belong either